

window constructed of a transparent material to allow the tested probe to be viewed.

6.11.4.2 Port for verification of axial flow. Depending on the equipment selected to conduct the axial flow verification prescribed in section 10.1.2, a second port, located 90° from the entry port for the tested probe, may be needed to allow verification that the gas flow is parallel to the central axis of the test section. This port should be located and constructed so as to allow one of the probes described in section 10.1.2.2 to access the same test point(s) that are accessible from the port described in section 6.11.4.1.

6.11.4.3 Port for calibration pitot tube. The calibration pitot tube shall be used in the port for the tested probe or in a separate entry port. In either case, all measurements with the calibration pitot tube shall be made at the same point within the wind tunnel over the course of a probe calibration. The measurement point for the calibration pitot tube shall meet the same specifications for distance from the wall and for axial flow as described in section 3.21 for the wind tunnel calibration location.

7.0 Reagents and Standards. [Reserved]

8.0 Sample Collection and Analysis

8.1 Equipment Inspection and Set Up

8.1.1 All 2-D and 3-D probes, differential pressure-measuring devices, yaw angle-measuring devices, thermocouples, and barometers shall have a current, valid calibration before being used in a field test. (See sections 10.3.3, 10.3.4, and 10.5 through 10.10 for the applicable calibration requirements.)

8.1.2 Before each field use of a Type S probe, perform a visual inspection to verify the physical condition of the pitot tube. Record the results of the inspection. If the face openings are noticeably misaligned or there is visible damage to the face openings, the probe shall not be used until repaired, the dimensional specifications verified (according to the procedures in section 10.2.1), and the probe recalibrated.

8.1.3 Before each field use of a 3-D probe, perform a visual inspection to verify the physical condition of the probe head according to the procedures in section 10.2 of Method 2F. Record the inspection results on a form similar to Table 2F-1 presented in Method 2F. If there is visible damage to the 3-D probe, the probe shall not be used until it is recalibrated.

8.1.4 After verifying that the physical condition of the probe head is acceptable, set up the apparatus using lengths of flexible tubing that are as short as practicable. Surge tanks installed between the probe and pressure-measuring device may be used to dampen pressure fluctuations provided that an adequate measurement system response time (see section 8.8) is maintained.

8.2 Horizontal Straightness Check. A horizontal straightness check shall be performed before the start of each field test, except as otherwise specified in this section. Secure the fully assembled probe (including the probe head and all probe shaft extensions) in a horizontal position using a stationary support at a point along the probe shaft approximating the location of the stack or duct entry port when the probe is sampling at the farthest traverse point from the stack or duct wall. The probe shall be rotated to detect bends. Use an angle-measuring device or trigonometry to determine the bend or sag between the probe head and the secured end. (See Figure 2G-6.) Probes that are bent or sag by more than 5° shall not be used. Although this check does not apply when the probe is used for a vertical traverse, care should be taken to avoid the use of bent probes when conducting vertical traverses. If the probe is constructed of a rigid steel material and consists of a main probe without probe extensions, this check need only be performed before the initial field use of the probe, when the probe is recalibrated, when a change is made to the design or material of the probe assembly, and when the probe becomes bent. With such probes, a visual inspection shall be made of the fully assembled probe before each field test to determine if a bend is visible. The probe shall be rotated to detect bends. The inspection results shall be documented in the field test report. If a bend in the probe is visible, the horizontal straightness check shall be performed before the probe is used.

8.3 Rotational Position Check. Before each field test, and each time an extension is added to the probe during a field test, a rotational position check shall be performed on all manually operated probes (except as noted in section 8.3.5 below) to ensure that, throughout testing, the angle-measuring device is either: aligned to within $\pm 1^\circ$ of the rotational position of the reference scribe line; or is affixed to the probe such that the rotational offset of the device from the reference scribe line is known to within $\pm 1^\circ$. This check shall consist of direct measurements of the rotational positions of the reference scribe line and angle-measuring device sufficient to verify that these specifications are met. Annex A in section 18 of this method gives recommended procedures for performing the rotational position check, and Table 2G-2 gives an example data form. Procedures other than those recommended in Annex A in section 18 may be used, provided they demonstrate whether the alignment specification is met and are explained in detail in the field test report.

8.3.1 Angle-measuring device rotational offset. The tester shall maintain a record of the angle-measuring device rotational offset, R_{ADO} , as defined in section 3.1. Note that R_{ADO} is assigned a value of 0° when the angle-

measuring device is aligned to within $\pm 1^\circ$ of the rotational position of the reference scribe line. The R_{ADO} shall be used to determine the yaw angle of flow in accordance with section 8.9.4.

8.3.2 Sign of angle-measuring device rotational offset. The sign of R_{ADO} is positive when the angle-measuring device (as viewed from the "tail" end of the probe) is positioned in a clockwise direction from the reference scribe line and negative when the device is positioned in a counterclockwise direction from the reference scribe line.

8.3.3 Angle-measuring devices that can be independently adjusted (e.g., by means of a set screw), after being locked into position on the probe sheath, may be used. However, the R_{ADO} must also take into account this adjustment.

8.3.4 Post-test check. If probe extensions remain attached to the main probe throughout the field test, the rotational position check shall be repeated, at a minimum, at the completion of the field test to ensure that the angle-measuring device has remained within $\pm 2^\circ$ of its rotational position established prior to testing. At the discretion of the tester, additional checks may be conducted after completion of testing at any sample port or after any test run. If the $\pm 2^\circ$ specification is not met, all measurements made since the last successful rotational position check must be repeated. Section 18.1.1.3 of Annex A provides an example procedure for performing the post-test check.

8.3.5 Exceptions.

8.3.5.1 A rotational position check need not be performed if, for measurements taken at all velocity traverse points, the yaw angle-measuring device is mounted and aligned directly on the reference scribe line specified in sections 6.1.5.1 and 6.1.5.3 and no independent adjustments, as described in section 8.3.3, are made to device's rotational position.

8.3.5.2 If extensions are detached and re-attached to the probe during a field test, a rotational position check need only be performed the first time an extension is added to the probe, rather than each time the extension is re-attached, if the probe extension is designed to be locked into a mechanically fixed rotational position (e.g., through the use of interlocking grooves), that can re-establish the initial rotational position to within $\pm 1^\circ$.

8.4 Leak Checks. A pre-test leak check shall be conducted before each field test. A post-test check shall be performed at the end of the field test, but additional leak checks may be conducted after any test run or group of test runs. The post-test check may also serve as the pre-test check for the next group of test runs. If any leak check is failed, all runs since the last passed leak check are invalid. While performing the leak check procedures, also check each pressure

device's responsiveness to changes in pressure.

8.4.1 To perform the leak check on a Type S pitot tube, pressurize the pitot impact opening until at least 7.6 cm H₂O (3 in. H₂O) velocity pressure, or a pressure corresponding to approximately 75 percent of the pressure device's measurement scale, whichever is less, registers on the pressure device; then, close off the impact opening. The pressure shall remain stable (± 2.5 mm H₂O, ± 0.10 in. H₂O) for at least 15 seconds. Repeat this procedure for the static pressure side, except use suction to obtain the required pressure. Other leak-check procedures may be used, if approved by the Administrator.

8.4.2 To perform the leak check on a 3-D probe, pressurize the probe's impact (P_1) opening until at least 7.6 cm H₂O (3 in. H₂O) velocity pressure, or a pressure corresponding to approximately 75 percent of the pressure device's measurement scale, whichever is less, registers on the pressure device; then, close off the impact opening. The pressure shall remain stable (± 2.5 mm H₂O, ± 0.10 in. H₂O) for at least 15 seconds. Check the P_2 and P_3 pressure ports in the same fashion. Other leak-check procedures may be used, if approved by the Administrator.

8.5 Zeroing the Differential Pressure-measuring Device. Zero each differential pressure-measuring device, including the device used for yaw nulling, before each field test. At a minimum, check the zero after each field test. A zero check may also be performed after any test run or group of test runs. For fluid manometers and mechanical pressure gauges (e.g., Magnehelic[®] gauges), the zero reading shall not deviate from zero by more than ± 0.8 mm H₂O (± 0.03 in. H₂O) or one minor scale division, whichever is greater, between checks. For electronic manometers, the zero reading shall not deviate from zero between checks by more than: ± 0.3 mm H₂O (± 0.01 in. H₂O), for full scales less than or equal to 5.1 cm H₂O (2.0 in. H₂O); or ± 0.8 mm H₂O (± 0.03 in. H₂O), for full scales greater than 5.1 cm H₂O (2.0 in. H₂O). (NOTE: If negative zero drift is not directly readable, estimate the reading based on the position of the gauge oil in the manometer or of the needle on the pressure gauge.) In addition, for all pressure-measuring devices except those used exclusively for yaw nulling, the zero reading shall not deviate from zero by more than 5 percent of the average measured differential pressure at any distinct process condition or load level. If any zero check is failed at a specific process condition or load level, all runs conducted at that process condition or load level since the last passed zero check are invalid.

8.6 Traverse Point Verification. The number and location of the traverse points shall be selected based on Method 1 guidelines.